Systematic Literature Review Tools: Are we there yet?

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Abstract. The number of publications is steadily growing. systematic literature reviews (SLRs) are one answer to this issue. A variety of tools exists designed to support the review process. This paper summarizes requirements for adequate tooling support and shows that existing tools do not meet all of them. We further investigate whether reference management tools can be used in conjunction with existing SLR tools to address the current gaps in supporting SLRs. For that we evaluate three reference management tools, JabRef, BibSonomy, and Zotero, against currently unaddressed requirements and outline the next steps.

Keywords: methods, systematic literature review, tool support

1 Introduction

With the ever-growing number of publications in computer science [15], and other fields of research, the conduction of meta studies becomes necessary to keep up [17, 20]. Kitchenham [10] introduced the *systematic literature review (SLR)* method to address this issue. The main idea is to systematically search and evaluate all existing publications regarding a specific topic.

Computer science researchers that conduct SLRs face three main challenges [18]: (i) For SLR novices, the learning of the SLR process and the definition of the research protocol is challenging. (ii) All SLR practitioners face difficulties assessing the quality of primary studies, a critical step within the conduction of an SLR, especially for qualitative studies. (iii) The access and acquisition of relevant studies across multiple e-libraries is a challenge. As a consequence, the need for appropriate tool support to address these challenges has been growing [1, 4, 8, 11, 18].

Currently, appropriate tool support is not yet achieved. To illustrate this, this paper (i) summarizes the requirements for adequate SLR tools, (ii) discusses the shortcomings of existing tools, and (iii) evaluates the capabilities of three reference

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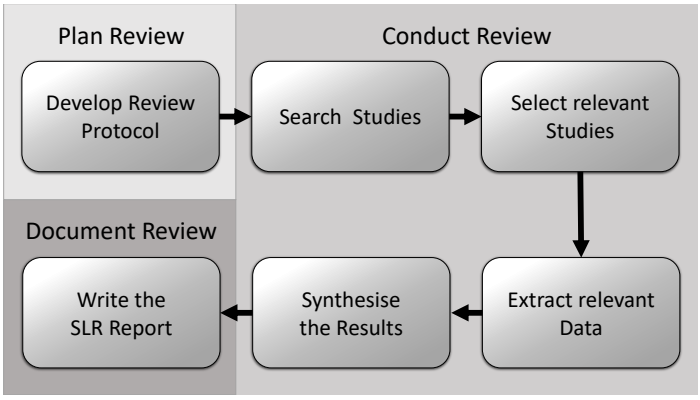

Fig. 1. Simplified SLR Process

management tools to investigate whether they can address these shortcomings. First, the overall SLR process and tool requirements are described in Sect. 2. Afterwards, we discuss in Sect. 3 that existing SLR tools do not fully meet these requirements yet. We claim that existing reference management tools can be extended and used in conjunction with existing SLR tools to overcome their current lack of support. Therefore, we evaluate three tools in Sect. 4. Finally, we conclude and outline the next steps required to close the remaining gaps in supporting SLRs in Sect. 5.

2 SLR Process and SLR Tool Requirements

The SLR process consists of three phases each with a set of steps [10]. These phases include the *planning* of the review, the *conduction* of the review, and the *reporting* of results. In Fig. 1 a simplified SLR process is depicted.

During the planning of the review, the review protocol is created, which especially describes the execution of the review. After the review is planned, it is executed during the conduction according to the defined review protocol: First the set of candidate papers is aggregated by executing the search strategy (*search step*). Then, the candidate filters are checked for inclusion using the selection criteria and quality instruments (*selection step*). Subsequently, the data is extracted (*extraction step*) and the results are synthesised (*synthesis step*). Finally, the results are reported in a format that makes them actionable and describes their significance.

The main challenge researchers face during the conduction of the SLR is during the search step. Commonly used e-libraries in the domain of computer science research, such as IEEE, arXiv, and ACM, do not support easy mass access, which is key to the SLR method as all relevant studies have to be found [1]. Furthermore, different e-libraries use different interfaces regarding their search

syntax and capabilities [1]. Thus e-library specific search strings have to be crafted and papers have to be retrieved individually. This introduces a lot of unnecessary manual effort for the researcher [1, 4].

Thus, adequate tool support is required. To focus the development of tools, Al-Zubidy and Carver [1] identified 35 tool requirements based on interviews. The need for support during the search step becomes evident in the top 8 requirements (R1–R8, ranked by the number of survey respondents that mentioned the requirement): search multiple databases with a standardized query (R1, 48 times), removing duplicate studies (R2, 13 times), provide filtering for studies (R3, 7 times), merging new results into the existing database (R4, 6 times), synonym recommendation for search strings (R5, 6 times), a repository for studies (R6, 6 times), standardized export formats (R7, 6 times), automatic download of full-text papers (R8, 6 times). These requirements should be fulfilled by SLR tools to adequate support researchers during their review.

3 Available SLR Tools in Computer Science

Several SLR tools specific to computer science are available to support the overall SLR process [2, 3, 5, 6, 9, 16]. The tools have been evaluated and compared in several studies, most recently by Marshall et al. [14] and Al-Zubidy and Carver [1]. Both of these studies concluded that, while (i) the overall process support was at least partially sufficient, (ii) the support for the search and management of literature on the other hand was only partially supported at best. This is a significant downside as integrated search and study management are the most requested feature for SLR tools (R1–R8) [1, 7, 11, 17, 18].

Since the review of Al-Zubidy and Carver [1] we identified two new tools by using the SLR Toolbox [13]: CloudSERA [19] and Thot [12]. Both do not provide any significant improvement concerning these aspects.

All in all, existing SLR tools have lacking support for the search and selection steps of the SLR process. To address this gap, we propose the use of reference management tools during the search and selection step, resulting in a conjunctive use with existing SLR tools to provide support for every step of the SLR process.

4 Evaluation of Reference Management Tools

There exists a variety of reference management tools that can potentially be used in conjunction with existing SLR tools. However, to allow adaptation to the needs of SLRs, we considered only open source reference management tools as candidates. Therefore, we extracted all open source reference management tools from a list provided by TUM [21]. Thus, we evaluate the JabRef[3], BibSonomy[4], and Zotero[5] reference management tools. We evaluate them against the requirements

[3] `https://www.jabref.org/`
[4] `https://www.bibsonomy.org/`
[5] `https://www.zotero.org/`

	R1	R2	R3	R4	R5	R6	R7	R8
BibSonomy	✗	✓	✗	✓	✗	✓	✓	✗
JabRef	(✓)	✓	✓	✓	✗	✓	✓	✓
Zotero	✗	✓	✓	✓	✗	✓	✓	✓

Table 1. Evaluation of reference management tools

enumerated in Sect. 2 (R1–R8). A summary of this evaluation is displayed in Table 1.

Zotero does not offer any way to search e-libraries. JabRef supports integrated search but requires separate search strings for different libraries (R1). The reason for this is the different search syntax and capabilities offered by the commonly used e-libraries. BibSonomy provides search in their own publication repository, but not in external e-libraries.

As reference managers, JabRef, BibSonomy, and Zotero, can manage repositories of references, including removing duplicate studies, and merging new entries into their database (R2, R4, R6). JabRef and Zotero support filtering studies based on their metadata, BibSonomy solely provides filtering based on the user defined tags (R3). Furthermore, JabRef and Zotero allow the acquisition of full-text pdfs to their corresponding reference (R8). Neither JabRef, nor BibSonomy, nor Zotero support the recommendation of synonyms for search strings (R5). All reference managers support the export of entries into commonly used formats, such as BibTeX, Endnote, and RIS (R7).

The reference management features and integrated search make JabRef the most promising candidate tool that can fill the support gap for the search and selection steps. Moreover, the standardized export formats it provides make the integration into any SLR tool chain quite simple. If JabRef can address the issue of requiring separate queries for the different e-libraries and the provision of synonyms for search string construction it could address all of its current shortcomings and fulfill all of the top 8 requirements.

5 Conclusion and Outlook

In this paper, we outlined the SLR tool landscape, requirements on them, and their current drawbacks. Open source reference management tools can fulfill some key requirements missing from existing SLR tools during the search and selection step of an SLR. Thereby, JabRef has the significant advantage over Zotero and BibSonomy that it offers integrated search, which is also programmatically available. With the integrated search being the most demanded feature and JabRef has partial support for it, we plan to extend JabRef to address the problem of e-library specific query strings (R1). With this extension, the conjunctive use of JabRef with existing SLR tools will close the gap in support for the search and selection steps. This will enable computer science researchers crafting a solid basis of their related work search. Reducing the effort required for conducting SLRs and improving the overall quality of scientific research.

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